Title: **Real-Time Augmented Reality Overlay for Advanced Data Visualization**

Internship Assignment

Project Plan Of Internship

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Project Plan for Internship Project

AR-Enhanced Material Measurement: Real-Time Data Overlay on Quality Control Machine Video Stream

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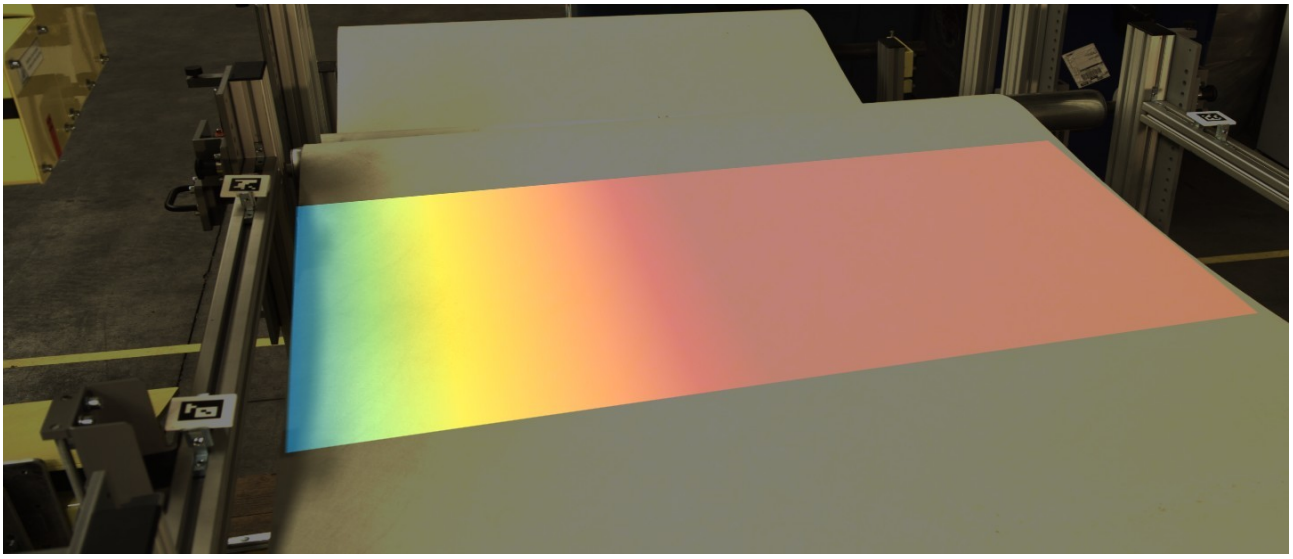
Project Overview

This project aims to develop an Augmented Reality (AR) system that visually represents basis weight measurement data on a live video feed from a high-end SICK camera. The system will utilize ArUco markers for edge detection, homography transformation for coordinate mapping, and overlay AR generated color-map images onto the live feed. This document outlines the project plan, including development stages, key milestones, and deliverables.



Company Background

Hammer-IMS, based in Herk-de-Stad, Belgium, is a high-tech machine builder specializing in industrial quality and process control solutions. The company offers contactless measurement systems for thickness, basis-weight, and anomaly detection in flat structures on production lines. Hammer-IMS bridges the gap between technology and user-friendly interfaces, providing easy-to-understand, color-spectrum-based results.

Business Case

Problem Statement

In the manufacturing industry, accurate and real-time monitoring of basis weight and material thickness is crucial for quality control and production efficiency. Traditional methods, such as processing CSV files, spreadsheets, and graphs, are complex and time-consuming, leading to potential errors and delays.

Solution

The proposed AR system visually represents measurement data using color-maps, where the color spectrum identifies data values. This modern AR approach simplifies data interpretation, making it easier than processing CSV files, spreadsheets, or graphs. It bridges the gap between machine operators and technology, providing a user-friendly interface. Additionally, the color-coded system helps manufacturers quickly and efficiently understand the measurement results, enhancing overall user experience and decision-making.

Benefits

Benefit	Description
Improved Accuracy and Efficiency	Real-time data monitoring reduces errors and allows for immediate corrective actions. Automation of measurement and data overlay saves time and reduces manual labor.
Enhanced User Experience	The AR system provides a clear and intuitive way to visualize measurement data. Color-coded color-map overlays simplify understanding measurement variations.
Better Decision-Making	Immediate access to real-time data enables quicker decision-making. Facilitates proactive maintenance and process adjustments, minimizing downtime and waste.
Customer Satisfaction	Enhances transparency and communication with customers through visual data representation. Improves customer trust and satisfaction with easier-to-understand results.
Competitive Advantage	Positions Hammer-IMS as a leader in industrial quality control technology with innovative AR solutions. Demonstrates commitment to leveraging advanced technologies for industrial process improvement.

Return on Investment (ROI)

ROI Component	Description
Cost Savings	Reduced labor costs and minimized errors lead to significant savings.
Increased Productivity	Enhanced efficiency and faster decision-making boost overall productivity.
Market Differentiation	The innovative AR solution can showcase how technologically advanced Hammer-IMS is.

Key Words and Meanings

Augmented Reality (AR)	A technology that overlays digital information on the real-world environment.
ArUco Markers	Fiducial markers that are used to determine the pose of a camera. In my case, I use them to set the edges of the material I am working with.
Homography Transformation	A method that maps points from one plane to another using a matrix transformation.
Basis Weight	The weight of material per unit area, used in quality control processes.
SICK Camera	High-end industrial camera used for capturing live video feeds in manufacturing environments.
Harvester Library	A Python library used for interfacing with industrial

Augmented Reality (AR)	A technology that overlays digital information on the real-world environment.
	cameras and acquiring images.
Color-map	A visual representation of data values using a color spectrum.
Real-time Data	The process of continuously tracking data in real-time.

Project Objectives

Objective	Description
Integrate SICK Camera with Harvester	Connect and configure the SICK camera using the Harvester library for live video capture.
ArUco Marker Detection	Implement ArUco marker detection to identify and track material edges.
Homography Transformation	Apply homography transformation to map marker coordinates to a fixed reference system.
Color-map Generation and Overlay	Generate color-map images based on basis weight data and overlay these on the live feed.
Real-time Update Mechanism	Ensure color-map images update in real-time with new measurement data.

Project Phases

Phase	Tasks	Milestones
Initialization and Setup	Research and planning. Environment setup (NumPy, OpenCV, Matplotlib, Pandas, Harvester). Camera integration.	Development environment set up. SICK camera integrated and capturing live feed.
ArUco Marker Detection	Study ArUco marker detection. Implement marker detection code. Identify material edges.	ArUco markers detected in live feed. Material edges identified.
Homography Transformation	Study homography principles. Implement coordinate mapping code. Validate transformation accuracy.	Homography transformation implemented. Accurate coordinate mapping achieved.
Color-map Generation and Overlay	Generate color-map images. Monitor measurement data. Overlay images onto live feed.	Color-map images generated. Images overlaid on live feed.
Real-time Update	Implement real-time data monitoring. Optimize	Real-time updates implemented. Real-time overlaid augmented reality

Phase	Tasks	Milestones
Mechanism	system performance. Conduct testing and validation.	color-maps update and regenerate simultaneously as results from data monitoring are updated.

Key Deliverables

Deliverable	Description
Code Base	Fully functional AR system code.
Documentation	Summary report, Project plan report, evidence of realization report, and reflection report.
Demo Video	Video showcasing the AR system in action with real-time color-map updates.
Project Report	Final report summarizing objectives, methodology, challenges, and results.

Project Timeline

Phase	Start Date	End Date
Initialization and Setup	Week 1	Week 2
ArUco Marker Detection	Week 3	Week 4
Homography Transformation	Week 5	Week 6
Color-map Generation and Overlay	Week 7	Week 8
Real-time Update Mechanism	Week 9	Week 10
Testing and Validation	Week 11	Week 12
Final Deliverables	Week 13	Week 14

Risk Management

Potential Risks and Mitigation Strategies

Potential Risk	Mitigation Strategy
Technical Challenges	Regular testing and validation. Continuous code optimization.
Performance Issues	Implementing fallback mechanisms for data accuracy.
Data Accuracy	Regular testing and validation.

Communication and Follow-up

Aspect	Details
Reporting Frequency	Daily progress meetings
Reporting Form	Weekly written reports and live demonstrations
Project Management Tools	Regular word files for task tracking and progress management
Team and Responsibilities	Intern: Primary development and implementation. Maarten De Groof: Project mentor, daily guidance and feedback. Tom Redant and Joost Poelmans: Occasional progress checks and feedback.

Conclusion

This project plan outlines a structured approach for developing the AR measurement system. By following this plan, systematic progress and successful completion of the project objectives will be ensured, enhancing data visualization and interaction to view measurement results in an innovative and simple approach.